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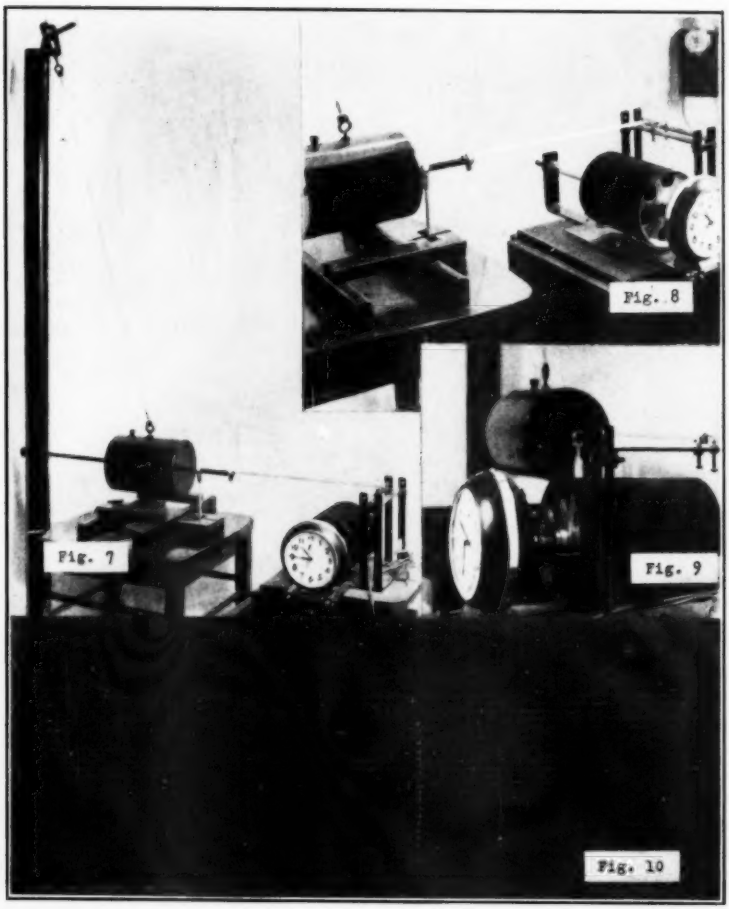
PLATE IV



SEISMOGRAPH CONSTRUCTED BY EDWARD MANTLE, HAMILTON, ONT.
Figures 7 to 10

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AMATEUR SEISMOLOGY IN THE MAKING

By EDWARD MANTLE

(with Foreword by Ernest A. Hodgson)

(With Plate IV)

Foreword: At my request, Mr. Mantle has written a brief and straightforward account of his initial interest in seismology and of his efforts to build a seismograph. He has included all essential details of the instrument as it now operates. The seismogram reproduced (Fig. 10, on Plate IV) is that of November 25, 1941. The epicentre of this earthquake was about 2,900 miles from Hamilton. It lies north of the line joining the Azores and Madeira Ids., and, with them, roughly forms an equilateral triangle.

The seismograph was designed and built by Mr. Mantle alone, with the exception of the drum, and the casting and drilling of the mass. His only tools were the usual household kit. He has shown considerable ingenuity in making a "Big Ben" alarm clock drive the drum with an extraordinarily good rate. The timing device, using home-made contacts on a "Pocket Ben" watch, is also his own design and works well.

The instrument is set up in the basement of his house in Hamilton, Ont. The tramway operates on a street only a block away. As the foundation of the house is on deep alluvium, any further increase in sensitivity would be useless at the present location.

Department of Mines and Resources,
Dominion Observatory, Ottawa,
December 5, 1941. ERNEST A. HODGSON.

* * *

SEISMOLOGY appears to be a subject about which, in general, those living in countries where earthquakes are not common seldom concern themselves; for one of the first questions asked by visitors inspecting my station is: "However did you become interested in earthquakes?" The answer is, I think, quite simple. As a

child, I read a book which referred to the recording of earthquakes at great distances, but without giving any indication as to how it was accomplished. This was sufficient to fire my imagination and create an interest in seismology; which, as the years went by, grew into a desire to discover and understand more about the great and destructive forces involved.

On November 1, 1935, a severe earthquake occurred with its epicentre near Timiskaming, Que.* It was, however, felt over most of eastern Canada and northeastern United States. The tremors were so pronounced in Hamilton that I decided to build a seismograph. As my knowledge of the subject was very limited, this instrument was a complete failure.

In 1937, I made a seismograph of the vertical-pendulum type which was more successful. It recorded the maximum surface waves due to a number of severe Pacific earthquakes. My only source of information in constructing this model was a newspaper article, which stated that a pendulum was used and that magnification was attained by the use of levers.

Feeling the need of more detailed information, I consulted the public library, but it yielded little of value. In response to a letter sent to the Department of Geology, University of Toronto, I was directed to the seismological station in Toronto, then under the direction of the Meteorological Office. I went there, meeting Mr. William Carroll (now deceased), who showed me the Milne-Shaw instruments and loaned me a book by Charles Davison entitled "A Manual of Seismology".

Thanks to Mr. Carroll's kindness, I was then able to start work on a seismograph of the horizontal-pendulum type. As I constructed it, the vertical supporting post consists of an 8-ft. section of 2-in. pipe, extending 3 ft. below the cellar floor into a solid foundation of concrete. At a point 24 in. above the floor level, the post was drilled to receive a hardened, 1/2-in. screw, the head of which had been ground to form a cup for receiving the pointed end of the horizontal boom, cup and point forming the lower point of suspension of the pendulum.

---

*This earthquake was discussed in an interesting article by Dr. Hodgson in this JOURNAL, vol. 30, p. 113, 1936.—*Editor.*

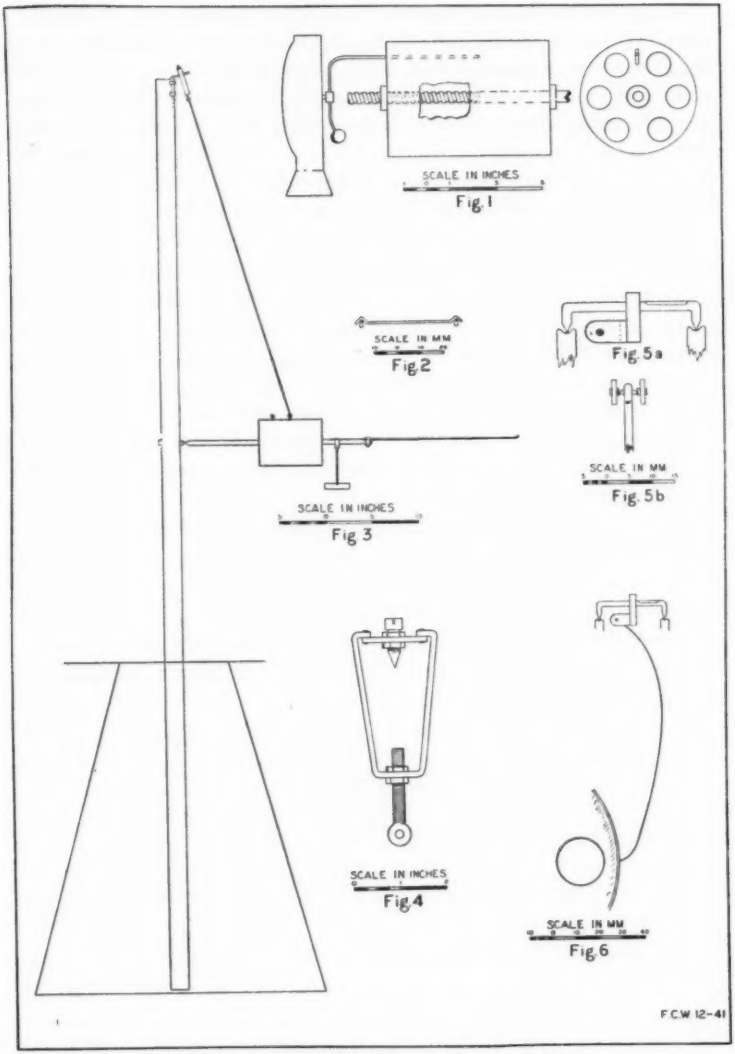
The upper point was a little more difficult to devise. A bracket, made of medium hard steel (8 by 1¼ by 3/16 in.), was bolted to the upper end of the post and so bent that its face was perpendicular to the supporting wire running down to the mass. The latter is a single strand of rope wire (diameter .041 in.), having a breaking strain of 300 pounds. A hardened 1/4-in. threaded bolt is held, by hexagonal clamping nuts, in a slot in the projecting end of the bracket. The upper end of the bolt is ground to a cup bearing.

The hardened steel point for the upper bearing is carried in a metal framework (Fig. 4). The period of the pendulum is determind by adjusting the verticality of the line of contacts of the two points of suspension by means of the two cup-bearing screws. The adjustment to a zero line is accomplished by shifting the upper bracket laterally, the bolts holding it to the post passing through slots in the bracket which give sufficient clearance for this purpose. The supporting wire runs from a 1/4-in. eyebolt in the bottom of the framework to a similar eyebolt screwed into the top centre of the 30-lb. mass mounted on the boom.

The mass consists of a cylindrical iron casting, 5 in. in diameter and 7 in. long, drilled to slide on the boom, which is made of a 1/2-in. steel rod about 20 in. long. It is held in place on the boom by means of a set-screw. The centre of the mass, as now set, is 11 in. from the lower suspension point. Originally the mass was set farther out on a much longer rod. It was redesigned as above to secure a higher magnification.

The extension lever is made of a strip of sheet aluminum, bolted to the outer end of the boom rod and bent into a V-shaped cross section to secure greater rigidity. The outer end is turned vertically upward 1/4 in. and carries a screw having its upper side filed away to make an horizontal knife-edge. One end of the connecting link, shown in Fig. 2, rests on this knife-edge, the other end on a knife-edge filed on the wire supporting a member of the recording lever (Figs. 5a, and 6).

The connecting link consists of a piece of flat spring steel (1.8 by .028 by .043 in.) having the ends bent as shown in Fig. 2. In bending this material, the bearing angles are naturally rounded and must be filed in order to form the sharp contacts required. If this is



DETAILS OF CONSTRUCTION OF SEISMOGRAPH
Figures 1 to 6

not done properly there is lost motion through side play. The shape of the link is such that its centre of gravity lies below the filed angles, and so maintains the horizontal alignment of the contact edges.

The supporting member of the recording lever consists of a piece of hard wire (diameter .075 in.) about 1.2 in. long, having about 1/4 in. at each end bent down and sharpened to form bearing points. These points rest in cups ground in the upper ends of two hardened steel screws held vertically in the cross member of the supporting frame shown in Figs. 7 and 8 (Plate IV). At one end of its upper edge, the wire is filed to form a knife-edge as indicatd in Figs. 5a and 6. A piece of soft steel (1/2 by 1/4 by 1/8 in.) is drilled to fit friction tight on the wire of the supporting member. To it is bolted, below that wire, an aluminum bracket which provides the bearing for the upper end of the extension to the pen. This extension is made of a piece of spring steel wire (diameter .017 in.). The upper end is soldered to a short cross-pin the ends of which are pointed. These rest in the cupped ends of screws entering from opposite sides of the projecting lugs of the aluminum bracket as shown in Fig. 5b. The bearing thus formed permits the extension to swing freely in the plane of the paper as shown in Fig. 6 but forces it to swing, with the supporting member, in a direction perpendicular to the plane of the paper as shown in that diagram. Originally, the writing point was a pen designed to carry a small drop of recording ink. In the present model, the end is brought to a smooth, sharp point and writes on smoked paper.

By means of the vertical, cup-bearing screws, the supporting member is made horizontal. By a proper choice of materials the lever assembly is balanced about the line of bearing points. The proper contact with the drum is obtained by a slight bend in the extension wire (see Fig. 6), which brings sufficient gravity into play to secure the optimum balance between the desired writing pressure and the undesired friction of the writing point on the paper. As originally designed the boom itself gave no magnification, the mass being clamped at its centre. In the present model the boom gives a ratio of about 2:1 and the recording lever a further ratio of 16:1, so that the overall magnification is about 32:1.

The instrument is oil damped. About 2 in. from the outward

end of the mass, an aluminum arm is clamped to the boom and extends 4 in. downward. At the lower end of this arm is an aluminum vane 2¾ in. long by 5/8 in. wide. This vane dips into a metal container (3¼ by 4 by 1 in.) containing grade 50 S.A.E. oil. The amount of damping is governed by the extent to which the vane is immersed in the oil. Damping at present is 5:1.

The most difficult of all parts to construct was a good recording drum. For this I an indebted to Mr. H. Pearson of Hamilton, a machinist, who kindly offered to do this work for me. The drum was cast of aluminum, turned to a circumference of 15 in., and 6 in. long. It is bushed at one end for a bearing and threaded at the other to travel along a 1/2-in. rod carrying six threads to the inch. It is driven from the minute arbor of a Big Ben alarm clock fitted with a counterbalanced driving crank of hard brass wire (diameter .115 in.). The crank enters a radial slot in the end of the drum as shown in Fig. 1 and in the photographs. The slot avoids the necessity for exact alignment of the clock arbor with the drum axis. Since the clock is removed and replaced each time the record is changed, some slight latitude must be granted.

Timing is done by means of a watch, of which the seconds-hand closes a contact at the end of each minute, thus operating a relay using two dry cells as a source of power. The details of the contacts can be seen in the upper right-hand corner of Fig. 8. The lever projecting upward and to the right from the left-hand terminal is made of strip brass .005 in. thick. It is 1½ in. long and tapers in width from 1/8 in. to 1/16 in. It is set to be lifted once each minute by a smooth drop of solder on the upper side of the outer end of the seconds-hand of the watch. This raises the lever sufficiently to close silver-faced contacts, one on the upper side of the centre of the above lever and the other on the under side of the outer end of the lever projecting upward and to the left from the right-hand terminal. This (latter) lever is made of strip brass .01 in. thick. It is about the same length as the other and tapers from 3/16 in. to 1/16 in. The contacts are set to a clearance of about a hundredth of an inch.

In the first model, the relay operated a separate stylus which recorded a dot each minute at the side of the corresponding seismo-

gram line. In the model now in use, the relay lifts the recording stylus, leaving a short break in the line each minute. There is no special hour signal.

The recording paper used is a hard-surfaced, plain white stock, 15½ in. by 6 in. It is fastened by being wrapped tightly about the drum and having the overlapping 1/2 in. stuck down by means of rubber cement. It is then smoked by rotating the paper-covered drum above a smoking coal-oil stove, with the tip of the flame just barely touching the paper. The drum is rotated at a speed sufficient to prevent scorching the paper; and, at the same time, the stove is moved back and forth across the drum until a light, golden brown (not black) smoke surface is obtained. It is then placed in service. After a day's recording has been completed, the sheet is cut from the drum and fixed by being run, once, through a bath of white shellac dissolved in methylated spirits (4 oz. to the quart). It is hung up to dry in such a way that the solution drips off at a corner.

To change the paper, the connecting link is lifted from the knife edges, the stylus is lifted from its bearing and the clock and drum removed. After a fresh sheet has been placed on the drum and smoked, the drum is replaced, the clock wound and replaced and the contacts for the time-breaks closed, so that the stylus is held away from the drum as it is being placed in its bearings, the connecting link is set on the knife-edges and the time checked. The contacts are then opened, allowing the stylus to fall on to the paper. To close the time-break contacts while performing this operation, I place a pencil on the upper contact but of course a small switch across the contacts would be much better. With practice it is possible to change the sheets in about 30 minutes.

In its original form (magnification 10, no damping, timing on separate line) a number of earthquakes were recorded, including the New Hampshire shocks of December, 1940, and the Colima, Mex., quake of April 15, 1941. These records were checked at the Dominion Observatory, Ottawa. Later, Dr. Hodgson inspected the instrument and suggested changes to yield higher magnification and to secure damping. At first, no change was made in the timing line.

These modifications were completed on June 25, 1941. The following morning, an earthquake was registered from an epicentre at a distance of 8500 miles. This was very encouraging, but I was anxious to secure even greater magnification and less inertia in the writing lever. I decided also to change the timing to a lifting of the recording stylus. All these changes were made and the instrument seems now to be about as sensitive as is permissible for a location in the cellar of a city dwelling, only a block from a street-car line. The record reproduced in Fig. 10 shows the effect of traffic on all the lines except for those from about 5^h to 9^h U.T. (1 a.m. to 5 a.m. E.D.S.T.).

While I have attempted to describe the development of the seismograph in a straightforward manner, little has been said which would indicate the difficulties encountered and the time spent in making many experimental parts by hand, only to abandon them on trial. Most of the difficulties were due to a lack of detailed information and to the absence of plans and specifications. This resulted in much experimental work, but the pleasure derived from making my own records has been ample reward.

With the instrument in its present form I am able to record most of the large earthquakes occurring in any part of the world. By means of the information obtained through the Dominion Observatory, I am now developing the ability to read my own seismograms and am able to learn at first hand something about the earth that moves at our feet.

454 King William St.,
Hamilton, Ontario,
November 29, 1941.

POSSIBLE ATMOSPHERIC PHENOMENA IN THE LUNAR CRATER *CONON*

By Frank Vaughn, Jr.

IN this paper the writer will place before the reader the results of recent work by himself, together with conclusions (tentative) formed, and will attempt a correlation with the earlier work of the late W. H. Pickering on the lunar crater Conon, while he was in Jamaica, B.W.I.

Conon is a conspicuous, if not large, crater in the Apennine range of mountains, and is easily located by prolonging a line from Aristillus through Autolycus southward into the interior of the range, where it stands alone as the most conspicuous depression for perhaps 200 miles around.

Before launching into a discussion of the writer's work, it will be pertinent, perhaps, to give a brief account of Pickering's work.

Pickering observed in Conon a marking which suggested a "cloud" of vapour, and it appeared to undergo a regular development each lunation. Also, to the southeast of the crater he saw brilliant white patches which he attributed to snow, and which the writer has seen, though a discussion will not be attempted of this latter work, as it was felt to be difficult to study because of the delicate nature of the marks and the difficulty of identification individually.

Pickering observed the "cloud" to begin to form on the floor at co-longitude 32°. (Co-longitude is a term defining the apparent altitude of the sun at any point on the central meridinial line of the visible hemisphere at mean libration, and refers to *longitudinal* altitude only, except at the center of the disc. Thus, it is roughly indicative of the phase, full moon occurring at co-longitude 90°, last quarter at 180°, new moon at 270°, and first quarter at 0°. In what follows co-longitude will be referred to as a number alone). It is then merely a faint whitish blob, but develops until reaching a maximum conspicuousness at 70°, then to fade in the afternoon in the crater, and to disappear entirely before sunset.

The writer's work follows, showing the development from sunrise to sunset of the "cloud", as well as other features of minor interest.

In this case, latitude is + 22°; longitude is + 2°; sunrise is

358°; sunset is 178°. The period of observation of the crater covered the period from February 6, 1941, to December 6, 1941, though observations are still being continued regularly. Nearly all work was done with a 6½-inch reflector of 59 inches focus, and of good optical quality.

SUNRISE

The appearance is a normal one, and comparable to that of many other craters of similar size, that is, very bright east walls, and a dull floor. Of interest are two or three darkish bands on the walls, which, though not conspicuous, are not difficult objects. They radiate from the approximate center of the crater, and are about two miles in width, on the average (see figure A in accompanying drawings).

20ª

From a large indentation in the shadow in the northwest of the crater there projects a vague, ill-defined whitish patch, and is perhaps suggestive of a vapour of some sort overlying the shadow in this region. There are present three of the dark wall bands, the most conspicuous of which is one on the southeastern wall; the east walls not now being so bright as at sunrise (see figure B).

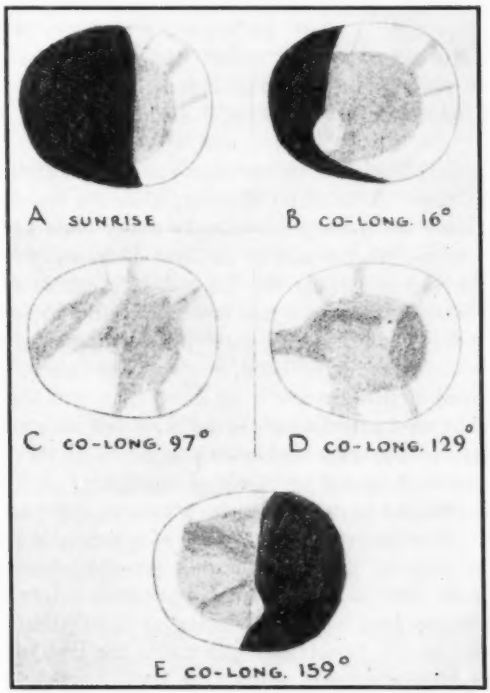
20° TO 70°

Shortly after 30° the shadow is absent from the east walls. The "cloud", or vapour, now projects from the northwest wall of the crater into the floor, and at about 40° a duller tip begins to form as an appendage to the main body on the southwest. The dark wall bands are now comparatively conspicuous, and there are present at least four of them. On July 4, 1941, at 28°, I drew a small craterlet on the floor, which could hardly have been much more than a mile in diameter, and which agreed well with one seen by Pickering a few degrees of co-longitude earlier. H. M. Johnson, drawing simultaneously at another station with equally good seeing, using an 8-inch aperture, did not confirm the craterlet, though general agreement of other detail in the crater was pleasing. The by now bright "cloud" continues its development, moving across the floor in a southeast direction, and preceded by the brightening tip, finally reaching a maximum size at about 70°, and is then indeed an imposing object, covering about one-third the total area of the floor (see figure C).

70° TO 100°

The entire crater changes but little during this period, and the "cloud" remains of about the same brightness and size. There have been observed, at similar periods of different lunations, however, differing appearances of the marks, which cannot very well be ascribed to observational errors.

S



W E

N

DRAWINGS OF LUNAR CRATER *Conon*
Figures A to E

(*Note by Author.*—On Drawing C the brightish band traversing from *NNW* to *SSE* seems to be more prominent than I had intended.)

100° TO 140°

Very shortly after 100° the "cloud" begins to diminish perceptibly

in size, and to begin a retreat to its source, the northwest wall, followed by the fainter tip. The wall bands are well seen until shadow sets in on the east wall, and the bands on the south wall can even then be seen, though fainter than formerly. By 140° the "cloud" has retreated so far as to be almost indistinguishable from the northwest wall, and might be passed over entirely by a casual observer, were it not for the existence of the faint and small tip (see figure D).

140° TO SUNSET

Very shortly after 140° the "cloud" disappears entirely; the west walls become very bright, and there appear on the floor some vague dark areas, which are present until shadow obscures them (see figure E).

It will be noted that the writer observes a much earlier development of the "cloud" than did Pickering; also, the latter ascribed a definite maximum for the object, while the writer finds a broad maximum of 30° or so. In the case of the first discrepancy between the two observers, it seems likely that an actual change of development is not improbable, while in the case of the latter difference, the point is difficult to decide, as Pickering *may* have been speaking of a sharp maximum, while on the other hand, he may have referred to a more delicate point of largest size.

Accepted by most professionals is the belief that the moon has long since relinquished any appreciable atmosphere, and they have consequently practically ceased any study of its surface. While the published proofs *against* a lunar atmosphere are many, there are a number of proofs *for* the existence of an envelope of appreciable density, and as the writer believes that they are not generally known, he will attempt to place some of the more important ones before the reader.

(1) There has been observed, during an occultation of Jupiter, a darkish band on the planet, and adjacent to the limb of the moon; suggestive of some absorbing medium.

(2) *Science Digest*, Nov., 1941. A discussion of a probable lunar atmosphere by Dr. Roy K. Marshall, of the Franklin Institute. "A one-inch meteoroidal body striking the moon with a speed of twenty miles per second, the average speed of meteors, would produce an explosion easily seen in telescopes on the earth. The fact that such flashes have not been observed is proof that the meteors are checked in their fall by some type of atmosphere, which either destroys them

completely, or so reduces their speed that the final impact is not visible". Dr. Marshall also believes that the streak of light produced by the burning out of the meteor would not be visible on the earth. He adds that the moon's atmosphere is much thinner than the earth's, but that it consequently extends much higher.

(3) Local obscurations have been seen on well known regions of the moon, and many cannot be ascribed to atmospheric haze on the earth, poor telescopes, etc.

In Plato there has been observed several times a mist which appeared to cover the floor, and to obscure detail normally visible at that time. In sunrise obscurations of the floor the appearance regained normality after the sun had gained slightly more altitude. Obscurations of haze have also been observed in Messier and Pickering, in Pico, and in Timocharis; the writer has seen a hazy appearance of Messier and Pickering, as well as of Pico. The following is from Goodacre's *The Moon*, in reference to Tycho: "Elger found for some unexplained reason, the floor was never very distinct, and Birt found the floor so misty and ill-defined for some years that he failed to detect the small hill on the W. side of the central peak, which was easily seen when the mistiness cleared away".

(4) It has been found that the diameter of the moon is 4 seconds of arc larger than the diameter computed by occultations, here suggesting possible evidence of atmospheric refraction.

(5) Though not an argument *for* the existence of an atmosphere, certainly one dealing almost a death blow to the spectroscopic evidence against a lunar atmosphere is the fact that it has been reliably stated that with spectroscopes now in use *it would be quite impossible to detect a rare atmosphere*, should one exist.

Returning now to Conon, an appearance suggestive of an atmospheric nature is the fact that the "cloud" actually moves across the floor preceded by the tip, growing larger the while, and to subsequently retreat followed by the tip, and waning in size at the same time.

If the incident light theory (that theory which is intended to explain changes in *brightness* by the changing altitude of the sun above a mark) is to be accepted, an area should have the same appearance at equal times before and after noon, and in the case of a rough

surface to experience a maximum of brightness at noon also. The "cloud" appears to have complete disregard for this theory. The incident light theory does not allow for movement, or for changes in shape of a mark.

There are other regions on the moon as well which have no satisfactory explanation for their behaviour as yet, and if this paper has only served to stimulate the reader to some serious thinking on the earth's nearest neighbour, or to arouse sufficient interest to cause him to attempt observation of this or any of the other marks, then its goal will have been achieved. Correspondence with prospective observers of the moon will be heartily welcomed.

J. Y. M. and W. A.,
Rochester, N.Y.

ASTROLOGY AGAIN

By C. A. CHANT

IN the November 1941 number of this JOURNAL there was printed a short article which had appeared in the *Scientific American* over the familiar editorial initials, A.G.I. The title was "What to do about Astrology", and its writer expr l the conviction that little progress will be made in the campaig.. against that pseudo-science until there shall be an improvement in the general standard of education. With that I am inclined to agree.

Some years ago the members of the Royal Astronomical Society of Canada at Victoria, B.C., made a strong protest against the broadcasting of astrological addresses, and soon afterwards they disappeared from our radio programmes.

In the newly-constituted magazine *Sky and Telescope,* which aims to be the organ of a national league of societies of amateur astronomers, I notice that one of the proposed 'planks' in the editorial policy is opposition to astrology. Wise continuous efforts of this sort will help to prepare the way for the displacing of foolish superstition by well-founded scientific information.

Many years ago I bravely set out to dig down deep into the history and principles of astrology. One of the first things I struck was the term "House", but nowhere in the works at my command could I obtain a clear definition of it. Instead there was a lot of loose jargon. The writers of the books I consulted either had no clear concepts or did not wish to be definite in their statements—perhaps both.

Somewhat later I acquired an attractive volume entitled "The Mystery and Romance of Astrology".[1] It contains much historical information about astrologers from the time of the patriarch Abraham, many portraits and other illustrations, and a mass of curious knowledge. The author also endeavours to explain how the astrologer worked. First he describes "the erection of the Twelve Houses of Heaven". I presume he quotes from some old authority when he says (page 86):

[1]By C. J. S. Thompson, London, 1929.

The whole celestial globe is divided into four equal parts by the horizon and meridional line. Each quadrant is then divided into three equal parts, by lines drawn from points of section in different parts of the horizon and meridian, at equal distances from each other. We shall then have the whole globe divided into twelve equal parts, which are called the "Twelve Houses of the Heaven".

Simply a jumble of words without any definite meaning!

Four pages later we read:

There were however several important matters for him to remember, such as the 'directions'. So-called circles of position were drawn through the north and south points of the horizon and any two points of the Zodiac, called the 'Significator'. The 'Promissor' (the Sun, Moon or Planets according as they had to be considered) and the arc of the equator included between these circles was their 'directio'.

Another jumble equally meaningless!

Some definiteness came into the geometrical constructions upon reading a book in German.[2] Here the twelve houses are plainly defined and illustrated by clear drawings.

In order to comprehend clearly the definitions to be given. one should have at hand a celestial sphere mounted with a fixed horizon and a movable meridian, but in the absence of such I shall describe the various lines and circles as clearly as I can.[3]

We appear to be at the centre of a great sphere formed by the sky. This is the *celestial sphere*. We see only the upper half of it. The *vertical* is the direction assumed by the cord of a plumb-line. If produced indefinitely upward it cuts the celestial sphere in the *zenith;* if produced downward it cuts the celestial sphere in the *nadir*. A plane at right-angles to the plumb-line is the *horizontal plane* and when extended outward it cuts the celestial sphere in a great circle known as the *horizon*. It is midway on the sphere between the zenith and the nadir.

The celestial sphere appears to rotate from east to west on an axis which is really the axis of the earth, whose actual rotation is in the opposite or west-to-east direction. This axis when produced

[2]*Die Astrologie, Entwickelung, Aufbau und Kritik* von Arthur Krause. Leipzig, 1927

[3]Some pictures in *Our Wonderful Universe* by C. A. Chant would help in this presentation

cuts the celestial sphere in the *celestial poles.* The star Polaris is near the north celestial pole. The circle on the sphere midway between the celestial poles is the *celestial equator.* If the earth's equatorial plane were extended outward it would cut the celestial sphere in this circle.

Next let a plane be drawn through the zenith, the north celestial pole and the observer. This is the *meridian plane* and it cuts the celestial sphere in the *meridian;* and the points where it intersects the horizon are what we mean by the *north* and *south points.* Midway between them along the horizon are the *east* and *west points.* The celestial equator intersects the horizon in the east and west points. The great circle which runs through the east point, the zenith, the west point and the nadir is the *prime vertical.*

There is one more important circle. The sun appears to move among the stars on a great circular path which it completes in one year. This circle is called the *ecliptic* and the plane it is in is the *ecliptic plane,* which is inclined to the equatorial plane at an angle of approximately 23½°. If a straight line be erected through the observer at right angles to the ecliptic plane it will cut the celestial sphere in the *poles of the ecliptic.* The north pole of the ecliptic is in the constellation Draco but there is no prominent star near it. It is in R.A. 18h., decl. 66½°N. Of course the length of the arc joining the north celestial pole and the north pole of the ecliptic is 23½°. The ecliptic has a definite fixed position among the stars but, as it is half above the celestial equator and half below, it seems to move up and down on the sky as the celestial sphere rotates on its axis.

We are now ready to define the "Houses". Each is a definite area of the celestial sphere and is bounded by two semi-circular arcs. Consider the position of the ecliptic at some particular moment—say, when a child is born. Let us think of it as running from some point on the western horizon across the sky to the opposite point on the eastern horizon and then continuing upon the half of the celestial sphere below the horizontal plane back to itself on the western horizon.

Next, think of the point where the ecliptic cuts the eastern horizon; call it 1. From it proceed downward and along the ecliptic

for 30°; call that point 2. Then go on 30° farther to point 3. Continue to mark off 30-degree arcs along the ecliptic and denote their ends by 4, 5, 6, etc. Point 7 will be on the western horizon and 8, 9, 10, 11, 12 will lead us back to the initial point 1 on the eastern horizon. These twelve points divide the ecliptic into 30-degree arcs.

We must now draw the twelve semi-circular arcs which will form the boundaries of the Houses. They all start from S, the south point of the horizon, and end at N, the north point. The first goes through 1; it is really a part of the horizon. The second runs from S through 2 to N, and the area between it and the first is the First House. The third semi-circular arc runs from S through 3 to N, and with the second forms the Second House. Similarly with all the rest. They start at S and individually pass through 4, 5, ... 11, 12, and end at N. The successive houses are numbered up to twelve. Each is shaped like the sections of orange-peel obtained by cuts running along great circles from the stem to the nose of the orange.

The First House is just coming up in the east and is called the *ascendant;* the Seventh House is just sinking in the west and is called the *descendant.*

Having built the houses it is now the business of the astrologer to place within them the precise positions of the planets and some of the fixed stars at the moment when his client was born and then deduce what of good or evil shall befall him in the future. What could be more ridiculous? It assumes that the poor human has no free will whatever, but that his fate is absolutely determined by the configuration, at some particular moment, of certain distant pieces of matter which we designate as heavenly bodies! If he had been only born two hours earlier or three hours later all would have been so different!

Just here a curious case arises. I have stated that the north pole of the ecliptic is in declination 66½°N. It follows that if a person is living in latitude 66½°N., i.e., on the Arctic circle, every day as the sky turns on its axis the pole of the ecliptic will come to that person's zenith and at that precise moment the ecliptic will coincide with the person's horizon. Under these circumstances the Houses will collapse into the horizontal plane. In other words the children

of persons living on the Arctic circle in Canada, Alaska, Russia, Norway and other countries, which happen to be born at the moment the north pole of the ecliptic is in their zenith, can have no horoscope! What a future for them!

In modern times three new planets have been added to the solar system,—Uranus in 1781, Neptune in 1846, less than a hundred years ago, and Pluto in 1930. Now who could say how these affect the lives of people on the earth? And yet it was not long before it was announced that Uranus governed "strange, sudden and extraordinary events", while Nepture was the "significator of great crises". Surely it is blasphemy to make such statements, although one may ask what do they mean anyway. What mischief little Pluto is up to I have not heard.

In ancient times it was commonly believed that the earth was the fundamental important body, and that the canopy of the sky was at no great distance. The sun, moon and other celestial bodies moved upon it in a mysterious way and one can almost forgive the people of the time for accepting the view that those bodies exerted an influence for good or evil.

As the centuries passed, continued observation and able reasoning combined to reveal more and more of the truth. In 1543 the great book of Copernicus embodying his theory was published. This demanded a revolution in the way of viewing the solar system. The earth was dethroned from its paramount position and became simply one of the revolving planets, all moving in their regular paths.

As time went on we learned methods to measure the distances of the planets and fixed stars. That bodies with masses which we can determine could at their enormous distances affect the lives of persons on the earth, reasoning, thinking beings could not accept without absolute demonstration, but such was not forthcoming.

It is commonly asserted that the adoption of the Copernican theory, especially after its completion by Kepler, Galileo and Newton, knocked the support from under the astrologer's business. However that refers only to persons who think for themselves. We are told that many still accept what the "soothsayers, the magicians and the astrologers", say. Indeed fresh evidence came to me a short time

ago that some people still hold that the earth is flat. Our special educational efforts should get under way at once!

Recently there was published in England a small book entitled "Astrology in the Light of Science and Religion".[4] I shall quote two paragraphs from it (pages 58-59):

> Astrology is based on the old belief in many gods, in polytheism. The ancient world believed in a whole host of deities and spirits, friendly and hostile, capricious and changeable, and often warring with one another. It tried to escape these, to flatter those, to find out which were the strongest and to appease them. Long before Astronomy destroyed Astrology by showing what the earth and the stars were it was practically undermined by belief in one God, and he a God of Righteousness and Love.
>
> As long as men believed in many gods all Science was impossible. There was no idea of unity in creation, no conception of universal laws. You could never tell what would happen next. You lived in constant terror and fear and spent endless time and trouble in trying to find out what these different gods were going to do. The Greek philosophers, with their speculative belief in one divine principle, were not taken in by Astrology. The Jews, with their practical trust in Jehovah laughed at it. The Christian Church led the way to distinguishing Astronomy from Astrology.

[4]By C. F. Rogers, Professor Emeritus of Pastoral Theology, King's College, University of London. London, S.C.M., 1s. 3d.; Toronto, Macmillan, 1941.

HER MAJESTY'S MAGNETICAL AND METEOROLOGICAL OBSERVATORY, TORONTO

By A. D. Thiessen

(Continued from volume 35, page 224)

Part VII.—Lieutenant John Henry Lefroy, Director of Her Majesty's Magnetical Observatory, "Longwood", St. Helena, January 31, 1840 to February 4, 1842

If ever there was a time when the prospects of a brilliant career before a young English soldier seemed hardly to exist it was towards the end of 1834. Twenty years had passed since the "great war" came to an end. Universal peace for all time, continual retrenchment of military expenditure, were the orders of the day, now, and for twenty years more,—until the outbreak of the Crimean War in 1854. Yet, in December 1834, a young soldier left the Woolwich Academy who, from the time he donned the uniform of a Second Lieutenant to the hour of his death in April 1890, contrived to find for himself ceaseless work such as few men in any profession or calling have ventured to undergo. He applied himself to that work with such zeal that it was said "In him you have a man of an energy that nothing can daunt." Although much of his work was carried on in isolation, it was conducted with such continuous and painstaking care that some of its results have been singled out by European scientific men as the most trustworthy of any that we have of similar character.[43] The young Second Lieutenant was the man who later became General Sir John Henry Lefroy.

His father had succeeded, in 1806, to the Rectory of Ashe, Hants, worth about £350 (his grandfather having bought it for three lives some years earlier) and there, in 1817, January 28, John Henry Lefroy was born. His father died in 1823. In 1826 a sister of the Duke of Wellington obtained for him the nomination to a cadetship in Woolwich Academy,—"no bad thing in those dark ages, when the State most absurdly gave a gratuitous education

[43]Lefroy, J. H., Autobiography, p. 315-317.

at both the military schools to the favoured few who had the interests to get into them. This was the rule down to 1831. My education, therefore, cost nothing after the age of fourteen, except the small charges for books and extras."[44]

Woolwich marked the end of Lefroy's formal education, and in later life he expressed his "regret to have never been at a University", a regret that "has been confirmed by the pleasure it gave me to have occasional opportunities from 1842 to 1877 of renewing intercourse with American scientific men, almost all connected with Harvard, from Benjamin Peirce to Asa Gray."[45]

In 1839 a letter from Major Edward Sabine produced the turning point in his whole career. It contained an offer for Lefroy to head one of the magnetical observatories to be established in an extensive magnetic survey.

Major Edward Sabine to Lieut. John Henry Lefroy

April 10th, 1839.

My dear Sir,

The enclosed report and its subjoined letter will make you acquainted with the particulars of the scheme of magnetic research which has been fully acceded to by Government.[46]

You will perceive it consists of two branches, a naval expedition and fixed observatories at certain stations on land. The naval branch is of course undertaken by the Admiralty, and the ships, or one at least, is this day commissioned. It is the intention of Lord Melbourne that the fixed observations should be carried into execution by the Ordnance Department, and Sir Hussey Vivian is to be acquainted with this intention to-day. The observatories are to be three in number, Canada, St. Helena, and the Cape of Good Hope; others are to be established by the East India Company, and other nations are to be invited to co-operate. The duration of the observations is not to exceed three years, and it is proposed that each should be under the direction of an officer of Engineers or Artillery, with three N.C. officers of his choosing. I know not how such employment might be suitable to your wishes, but from conversation I have had with Sir Alex[r]. Dickson, I think it most probable that he will look to you as the first person whose wishes he will ascertain. I therefore write this *private* note to give you a little more time than you might otherwise have for considering the subject, and to offer you any further explanation that you may desire in considering it. The Dublin observatory . . . will be the model on which the fixed observa-

[44] *Op. cit.*, p. 5.
[45] *Op. cit.*, p. 121.
[46] *Op. cit.*, p. 33.

tories will work. The officers who undertake their charge will have to be instructed there, and you may be quite sure that there will be no part of the duty of which you will not be able to make yourself fully the master.

Edward Sabine.[46]

This offer was eagerly accepted. Similar offers were made to two other officers, Lieutenant Charles Riddell and Captain F. Eardley Wilmot.[47] All three were taken off garrison duty to receive special instruction under the direction of Edward Sabine and the Royal Society. Sir John Herschel, the eminent astronomer, advised the young directors, and they also received instruction from Professor Humphrey Lloyd, D.D.,[48] at Trinity College, Dublin. They found this "short sojourn in academic groves a bright experience".[49]

Lefroy embarked on board H.M.S. *Terror* on September 27, 1839, and after a long and leisurely voyage of 126 days arrived at St. Helena on the 31st of January, 1840. "I well remember the interest, not to say emotion, with which I gazed at those historic precipices behind which my home was to be for three years."[50] He soon decided that the observatory should be on the grounds of Longwood House, which was given to him as a quarter, and he moved into it.

He hoped to be ready for observations to keep the magnetic term day of 29-30th May, but neither Wilmot nor Lefroy was in a position to do all that they wished. "Neither observatory was ready for occupation, but we made the best temporary arrangements that we could, and had corresponding observations of declination and horizontal force to produce, though nothing came of it beyond establishing the fact, since abundantly confirmed, that the larger magnetic disturbances prevail at the same time in

[47]This JOURNAL, vol. 34, p. 310, 1940.

[48]Humphrey Lloyd, 1800-1881, was for a while Director of the magnetic observatory established by his father at Trinity College, Dublin. In 1831 he succeeded his father as Erasmus Smith Professor of Natural and Experimental Philosophy, and in 1867 he became Provost of Trinity College. He drew up the plans for the colonial observatories established in 1839. See the *Dictionary of National Biography*.

[49]LEFROY, J. H., Autobiography . . . p. 35.

[50]*Op. cit.*, p. 40.

both hemispheres. I did not actually get to work in the new observatory before August."[51]

The greatest event of 1840 for the inhabitants of St. Helena was the solemn ceremony of the restoration of Napoleon Buonaparte's remains and their removal to France. The proceedings were instigated by Louis Phillippe and superintended by his youngest son, Prince de Joinville.[52] Lefroy was permitted to witness this ceremony.

In October 1841, Lefroy wrote to his sister in England:

"I suppose you know by this time the state of the case as to my return to England, and at any rate that I have but a small chance of eating a mince-pie with you at Christmas. I don't wish myself to leave the island before January, and do not expect to do so, *if* I return at all. I shall then complète two years of this observatory work, which, as I have to answer for the first arrangements, the most important, will be convenient to all parties. Two years will furnish three volumes of figures. Think what a voluminous author I shall be!"[53]

In August of 1841 Lefroy had been offered the observatory at Toronto and with it the magnetic survey of British North America. He gladly accepted it and was relieved of his charge by Lieutenant S. W. Smythe, R.A., some time in December. He remained only long enough to instruct him in his duties and on the 4th of February, 1842, left the island and landed at Hastings on the 4th of April.[54]

He remained in England fourteen weeks, very busily engaged in preparing for the magnetic survey. He embarked for Quebec in the *Prince Rupert* transport on July 14th, 1842, and although transports, being hired by the day, shortened sail at night to make the voyage as long as possible, he landed in Quebec on August 25th after a voyage of six weeks.

Lefroy began at once to take observations. He observed at seven stations in Lower Canada, and went by way of Lake Champlain to New York. He did not get to Montreal until September 15, after observing at eleven stations in the United States. He arrived in Toronto on October 23rd.[55]

[51] *Op. cit.*, p. 42.

[52] Lefroy's account of these ceremonies is interesting, and is published as a separate article herewith. *Vide op. cit.*, p. 43-49.

[53] *Op. cit.*, p. 55.

[54] *Ibidem.*

[55] *Op. cit.*, p. 61.

In Toronto, as we have already seen, Younghusband was in charge of the observatory until Lefroy's arrival, and again during his absence on the magnetic survey of British North America. Lefroy's effective administration of the Toronto observatory did not begin, therefore, until his return from northern Canada towards the end of November 1844.[56]

[56]An account of Lefroy's magnetic survey was published in this JOURNAL in April, 1941, and in the May and June number the work of Younghusband as director in Lefroy's absence was reviewed. In our next instalment we shall publish the letters of Lefroy, written while he was director in Toronto, 1842-1853.

THE REMOVAL OF NAPOLEON'S REMAINS FROM ST. HELENA TO FRANCE, OCTOBER 1840.[1]

By J. H. Lefroy, edited by A. D. Thiessen

Introduction

Lieutenant (later General Sir) John Henry Lefroy, R.A., was one of the young officers of the Royal Artillery chosen in 1839 to head magnetic observatories in various parts of the empire in an extensive survey of magnetic phenomena. The survey was conducted by the Royal Society with the support of the British Government. Lefroy was sent to St. Helena and while there was permitted, as one of the British officials on the island, to witness the disinterment of the remains of Napoleon Buonaparte, Emperor of the French.

Lefroy's letter to his sister, written at the time, delivers a plain unvarnished tale. It is here reprinted for the entertainment and satisfaction of those of us engaged in wishful thinking about other little corporals.

The literature about Napoleon has been fairly thoroughly sorted and indexed, but this fragment has, I believe, gone unnoticed.

Lefroy's Memoir.

The greatest event of 1840 was the arrival of the French frigate, *La Belle Poule*, on the 8th October (Captain Hernoux), bringing the Prince de Joinville, youngest son of Louis Phillippe,[2] Marshal Bertrand,[3] General Gourgaud[4] (two of the companions in exile of

[1]Appreciation is expressed to Colonel Charles MacInnes of Toronto, a grand nephew of Lady Lefroy, for permission to reproduce part of General Sir John Henry Lefroy's *Autobiography*, which was "printed for private circulation only", in 1895.

This excerpt is from pages 43-47.

[2]Francis, Prince de Joinville, third son and fourth child of Louis Phillippe, King of France, 1830-48.

[3]General Henri Gratien Bertrand, 1773-1844. Bertrand had been commander in Spain and Italy, 1795-97. Later he was defeated by Blücher at Wartenburg in a brilliant minor action that culminated in the battle of Leipzig, 1813. He accompanied Napoleon to Elba and shared his exile on St. Helena. After Napoleon's death in 1821 he returned to Paris and was pardoned by Louis XVIII.

[4]Baron Gaspard Gourgaud, 1783-1852, was one of the generals who accompanied Napoleon on his campaigns after 1805. He saved Napoleon's life at

Napoleon), M——,[5] his valet, and the Count Chabot, afterwards well known as Count Jarnac,[6] who was the Commissioner (French) appointed to superintend the solemn removal of the remains of Napoleon to France. On our side, Captain Alexander, R.E.,[7] was appointed Commissioner. The Governor,[8] who was an old Peninsula soldier, hated the whole affair, shut himself up, and left the management and reception to Colonel Hamelin Trelawney, R.A.[9]

The Prince was a fine young man, about six feet three inches in height, but slightly built. He declined society, and went about in his loose white trousers, old coat, and tarpaulin hat, much as he pleased. About thirty years later I was presented to him at Shoeburyness, and, on reminding him that it was not the first time, I had found him very gracious. He and I alone remain of those who witnessed this disinterment.[10]

It was Louis Phillippe's policy to put as much ceremony as possible into the solemn restoration of Napoleon's remains.[11]

Brienne in 1814 and shared his exile on St. Helena. He assisted in the publication of Napoleon's memoirs, dictated in exile. See his *Sainte-Hélène; journal inédit de 1815 à 1818 avec préface et notes de Vicomte de Grouchy et A. Guillois.* Paris, 1899.

[5]Louis Marchand. At Plymouth, before sailing into exile, Napoleon was allowed to take twelve servants. Louis Marchand, then twenty-four years old, was picked for the post of first valet. His mother was "the good Chanchan", nurse to the King of Rome. He was both servant and friend to Napoleon.

[6]Philippe-Ferdinand-Auguste de Rohan Chabot, Comte de Jarnac, 1815-1875, was a French diplomat. In 1874 he was named ambassador for France in London.

[7]That Captain Alexander, R.E., was in charge of proceedings for the English at this time appears to be all that is known about him.

[8]Major General Middlemore, Governor of St. Helena, 1836-42. For his part in the Peninsular war, particularly in the action at Talavera in Portugal, 1809, Wellington recommended him for promotion: "He is an excellent officer, and if his conduct then did not, I may say, demand promotion, his good conduct and attention to his duty would warrant it."

[9]Colonel Hamelin Trelawney, R.A., succeeded Middlemore as Governor of St. Helena in 1842. He died in 1846.

[10]Lefroy. "George Bennett, now (1887) resident at Cape Town, reminds me that he also was present on this occasion." Bennett was an old schoolfellow of Lefroy's, and in 1840 held a commissariat-clerkship on St. Helena. See Lefroy's *Autobiography*, p. 41, and p. 43.

[11]Louis Phillippe was the umbrella man of the Orleans monarchy, and the words of Flambeau in Rostand's "*L'Aiglon*" aptly describe his position: "*le roi,*

Many days were wasted over negotiations—discussions as to what honours should be paid, how many guns should be fired, and the like. Our Government had directed the Governor not to recognize him as an emperor if he could help it! The Governor was not going to be bothered with a diplomatic question, and the French speedily found out that they had only to put on pressure to carry that point, which determined the land salute as 103 guns. But the sturdy captain of H.M.S. *Dolphin*, Littlehales, declared that he was "General Bonaparte" in his instructions, and as a general only would he acknowledge him; he should only fire 21 guns. Here was a delightful field for diplomats, but Count Chabot's gammon was all in vain. Littlehales stuck to his point, and the Prince refused to return his visit or go on board his ship.

Note by Lady Lefroy

Since these pages were written, a long-lost letter of Lieutenant Lefroy to one of his sisters, giving an account of the opening of Napoleon's tomb, was found, and it is inserted instead of the recollections which were written in 1887. The accuracy of the latter is remarkable, but the letter written at the time is fuller, and will probably be more interesting to the reader.

Letter from J. H. Lefroy to his Sister

Longwood,[12] St. Helena,
October 17th, 1840.

You will not give sixpence for an account of the removal of Boney's remains that is not written at the time, so I mean to give you a plain matter-of-fact description, to repress my Pegasus, and not to be either poetical or sentimental.

I had the good fortune, by special favour, to witness the whole. The ceremony, however, was so far private, that none were allowed

le roi même à cette heure (1830) *n'existe qu' à la condition d'être bonapartiste*". They were even more true in 1840, when the crescendo lip-service at the Napoleonic altar culminated in the removal of the bones of Buonaparte to *les Invalides* in Paris, in preparation, perhaps for a later ceremony at this shrine (1940) at the behest of the evil spirit that whispered, "*In nomine Napoleoni omne genu flectatur.*"

[12]During his exile on St. Helena Napoleon was lodged at Longwood, where he died in May 1821. Longwood was Lefroy's residence while he was director of the magnetic observatory there, 1840-42.

to be present but those officially appointed. It was agreed that the exhumation should commence at midnight on the 5th, twenty-five years to a day since he landed on the island. The parties present were the Count Chabot (Chief Commissioner), Marshal Bertrand, General Gourgaud, Las Cases,[13] Marchand, Archambeau,[14] and another old attendant of the Emperor's, two or three French captains, L'Abbé Coqueran,[15] and four or five of the English colonial authorities, the judge, etc.

It is in a wild spot that he lay, and the midnight assembly formed as picturesque a scene as I have ever witnessed. The sentries posted on the hills, the black labourers, the soldiers of the guard and working party, mixed up with the muffled figures of the authorities attending, in the imperfect light of the lanterns by which they worked, would have formed a scene for Rembrandt.

I arrived after twelve, when the work was commenced. The iron railing was down on three sides of the tomb, the ground strewn with tools and tackling, and they were then loosening the slabs of freestone that sealed the vault. One by one, by main force, with levers and rollers, they were heaved off, and we saw the walled space, filled in with clay and stones, at the bottom of which he lay. The night was wet and dark; it helped the picturesque, but it added nothing to the comfort or the facility of the work; but the workmen plied their task so well that in three hours and a half, seven feet of tamping were removed, and the solid masonry was reached.

The first layer of masonry, besides being set in most tenacious cement, and of the hardest stone, was clamped and leaded together, as if those who had laid him there had meant to defy disturbance. Nearly five hours were consumed in removing the thickness of one foot of the covering. The lower part, to render it perfectly water-tight, was all Roman cement, as hard as stone. However, early

[13]Emmanuel-Auguste-Dieudonne-Marius-Joseph, Marquis de Las Cases, born in 1766 in the Château Las Cases in Languedoc, chose to accompany Napoleon to St. Helena, perhaps with the purpose of becoming the Homer of a new Iliad. His "Diary aboard the Belle Poule" is another record of this exhumation Odyssey.

[14]Two brothers Archambeau, whose rank was that of footmen, later that of coachmen, and who were known to be very excellent drivers, went with Napoleon to St. Helena in 1815.

[15]Abbé Coquereau's *Relation* is another account of this event.

in the morning they found out, much to everybody's delight, that they had got down to the actual slab of the sarcophagous, and had not much more to do.

Interesting as the occasion was, one does not stand out in the wet and cold, from midnight to sunrise, without some little impatience. Bertrand disappeared early, and many more from time to time were longer getting their coffee than was exactly necessary. Some sort of accommodation of sofas and chairs had been provided in the house hard by. I got a doze for half an hour in the nest of the officer on guard. It was necessary to let in the bolts and rings into the upper stone of the vault; this took some time, but by twenty minutes to ten everything was ready. Imagine our eager looks as one heave at the tackling lifted the massive slab, and lo! before us were the relics of the "mighty dead," in their still repose.

As an official formality, it was requisite to measure the vault, the coffin, etc., to identify them. This sort of thing had been done by Count Chabot at every step. The Abbé then took his post at the head of the grave, and we listened, bareheaded, to the "De Profundis," and other prayers which he pronounced. His own splendid robes (the crucifix and holy-water vessel were new to me), and the Latin service, with the low response of two pale choristers who stood on either side, made a very impressive part of the ceremonial. This service was short, but he then went aside and pronounced a long one all to himself.

The doctor had tools for making a hole through the coffins (tin, mahogany, lead), to inject creosote, but they decided on opening it entirely. There had been many strange rumours circulated, such as that the body had been changed. They wished to set all these to rest. However, one of the officials entered a protest against the opening, and would not be present, and it is a question whether there was proper authority for so doing. No one was allowed to be present but the Commissioners and others ordered to attend. The body was found perfectly preserved, as if buried yesterday—the features distinguishable, the dress unimpaired. Some were affected even to tears at seeing so wonderfully revived, as it were from the dust, the master they had loved and served. I heard Marchand say that he was almost more like himself than when interred. The slight swelling had restored some-

thing of roundness to the features; the beautiful hand, for which he was remarkable, was calmly extended beside him; the vase, the coins, the decorations, all in their former place. The body was, I believe, not embalmed, so that this is due to the manner in which everything had been hermetically sealed; corruption and the worm had spared him who had given them so many a banquet. It seems as if half the horrors of death were gone, when even to the body it may thus become a long unbroken sleep.

You may have read the account of the ebony coffin they had brought with them; his own coffins were all deposited inside it, and the whole again in another sort of sarcophagous of oak, making an immense weight (twenty-three cwts.) for the hearse which was to take it to the ship.

The procession did not start from the tomb before four in the afternoon. It was a small one, for there are few troops here, and the weather was vile—a wet cloud over the whole time.

The island militia regiment marched first, then the regulars, then the priest with his assistants bearing the crucifix preceding the hearse. It is almost worth while going to Paris to see the splendid pall. I have never seen anything so rich and beautiful. It is of immense size, I daresay fourteen by ten feet, of purple velvet richly embroidered (with golden bees), divided into four by a very broad cross of silver lace edged with gold. The embroidery of the border alone cost £1,000, beautiful scroll work, with magnificent wreaths at the angles, and outside of all a broad border of ermine.

The angles were held by Bertrand, Gourgaud, and Marchand. The Governor and an immense number of officers, French and English, followed. I saw the procession pass me twice, but preferred not joining it, which I was not obliged to do, and I did not follow it to Jamestown to see the embarkation. I was told, however, that this was a pretty sight. I fancied that as it was late and wet it might be deferred until next day, and I was tired enough with my night's watching to be glad to get home.

Minute guns were fired all the way, and a royal salute from the battery, but not from the English man-of-war. However, with this latter exception, everything was done as if he were emperor, a thing we never acknowledged before, which makes the *amende* to France and directly inculpates all preceding governments. I

would have stuck to the "General Bonaparte" as long as there was a "shot in the locker."

The Prince de Joinville met the procession at the wharf, and himself steered the boat that took off the body. He did not go about much, partly because the Governor was not able to entertain him, and there was nobody else to do so. He came one day to Longwood with a number more, including Bertrand. It was rather interesting to see Bertrand again on the spot with which his name is so much connected. I asked, might I have the honour of showing H.R.H. round the house? "Thank you, sare, I never drink wine," was his reply, in a very mild voice. He is extremely tall and thin, of a serious but very intelligent countenance, clever, gentlemanly, and very agreeable when he pleases; draws well, especially caricatures, plays the piano, speaks and reads English and Spanish, and is, in fact, a very superior person. He had not time to visit the observatory, and stayed but a few minutes.

Marchand and Bertrand came again, but I was out. However, I met them all two or three times, and saw a good deal of them, the Prince excepted. Bertrand and Las Cases, who paid me a long visit, asked me for a selection of island minerals, so I made one for each. All the French were eager to get them. One of my neighbours came to beg some one day. "Bless me, sir, they is a-craving of them everywhere." I gave away dozens. Nothing amused me so much as their anxiety to obtain relics of any sort or kind. Handfuls of earth, water from Napoleon's spring, leaves, flowers, bulbs —nothing came amiss to them. One merchant employed a stonemason to go over the hills and bring some of all he could lay his hands on.

I don't know whether I have ever mentioned that I have formed a collection of more than 200 specimens (of minerals) belonging to the island, which is very profitable to me. I make exchanges. I got from the French doctor some from the plains of Troy, and I shall have no doubt by-and-by some of real value and interest.

I must tell you one amusing thing. An English merchant vessel came around the point while the French were firing salutes all at once. She thought they were attacking the island, put about, crowded all sail, and fled for her life.

If I remember right, *La Belle Poule* put to sea the same evening,

the body lying in a kind of *chambre ardente* on the main deck. At that moment the relations of England and France were strained to the utmost degree. The audacious and aggressive policy of Lord Palmerston, coupled with the indolence and weakness of Lord Melbourne, had brought matters to such a pass, chiefly over the Syrian question, that a declaration of war was daily expected, and the moment the ship got beyond the three-mile radius she cleared for action. Bulkheads were knocked down, cabin furniture of a costly kind thrown into the sea.

Littlehales, in H.M.S. *Dolphin*, followed her at a safe distance, determined if he got a chance to pitch a shell or two into "old Boney's coffin." Being much the best sailor, he might have done it with impunity.

The French behaved handsomely.

[From here on the narrative tails off into rambling reminiscences, irrelevant to our present purpose.]—A.D.T.

REVIEW OF PUBLICATIONS

Manual of Astronomy, by R. William Shaw and Samuel L. Boothroyd. Pp. 305, 10¾ x 8½ inches. Cornell Coöperative Society, Ithaca, New York. Price $3.00.

This is a laboratory manual. It consists of 44 exercises which may be executed by the student—some in laboratory and others at night with or without a telescope. It is meant to guide the student taking a first course in elementary astronomy into the habit of making correct and careful observations and records. In no course is the old adage, that "one gets out of a course no more than the work he puts into it", more true than in laboratory astronomy. This is the first difficulty that the beginner in astronomy faces. He does not at first appreciate the power of carefully recorded observations. The manual should be a great help to any instructor in helping to impart to the student a measure of this appreciation.

Space is provided on the pages of the book for the great bulk of the work and the observations which the student is called upon to make, so that at the end of the term he will possess a complete record of his work. In courses of this nature there is always the difficulty of students borrowing from former students the record of their work. However, this difficulty is probably no greater with the authors' manual than with any other course that can be devised, and the instructor can vary the exercises somewhat from year to year to overcome as far as possible this undesirable result.

The reviewer would also recommend the book to the independent amateur taking up the subject as a hobby. So frequently the amateur who has started reading the subject is stirred with the impulse to make some observations of his own. He will be able to work through a large fraction of this manual with very little equipment, and, having done so, will be in a position to undertake more serious observation of some portion which he found most interesting and thus he may make real contributions to the subject. R. K. Y.

The Story of Variable Stars, by Leon Campbell and Luigi Jacchia. Pp. 226, 6 x 9 inches. Harvard Books on Astronomy, Blakiston, Philadelphia, U.S.A., 1941. Price $2.50.

This book is another of the series of nine Harvard Books on

Astronomy. This series of monographs is designed to present, in an elementary manner, the general picture of modern knowledge of the various fields of astronomy. The books that have so far appeared are well written, generously illustrated, and the paper and binding are of good quality.

The junior author of *The Story of Variable Stars* has, for several years, been studying and carrying on research in this field at the Harvard Observatory. The senior author, Mr. Leon Campbell, is so well known that he needs little introduction. It is a pleasure, however, to recall that he has been, for over forty years, a member of the Harvard Observatory staff at Cambridge, Mass., and Arequipa, Peru. Starting in 1899 as an enthusiastic amateur, with relatively little formal training in astronomy, he became an observer at Harvard, in the time of Professor E. C. Pickering. When under the latter's approval the American Association of Variable Star Observers was founded in 1911, with headquarters at Harvard, it was natural that Mr. Campbell should devote some of his enthusiam to the new organization. He has played an increasingly important role in this distinguished society, and many of the present active members received much of their early instruction and encouragement from Mr. Campbell. For the last few years, as Pickering Professor of Astronomy and Recorder of the A.A.V.S.O., he has been responsible for much of the accumulation and co-ordination of the hundreds of thousands of observations of variable stars contributed by the world-wide membership of this association.

With an author who has been so intimately concerned with the problems of observation by amateurs, it is natural that the presentation in this book approaches the subject from the observational point of view, and is written in such a way as to be readily followed by any intelligent layman.

The first third of the book discusses the practical observational problems, such as discovery, determination of magnitudes, and deduction of periods, of variable stars. Succeeding chapters discuss the various classes of variable stars, again from an observational and descriptive point of view.

A book of this type should help many of the present diligent observers of variable stars to visualize better the part their observations play, and encourage non-active amateurs to undertake systematic observations in this important field of astronomical research.

F. S. H.

NOTES AND QUERIES

Communications are invited, especially from amateurs. The Editor will try to secure answers to queries.

QUERY—THE POSITIONS OF THE STARS

In the HANDBOOK for 1942 I notice that the R.A. and Dec. of the stars and nebulae given on pages 65 to 74 are as of 1900. The table of data on page 6 gives no information on conversion to the co-ordinates for 1942. The American Nautical Almanac gives formulae for the increase in R.A. and Dec. but no information on the application of these to actual conversions. How then are the positions for 1900 converted to those for 1942? Perhaps this information might be given in future issues of the HANDBOOK.—N.S., Forest Hills, New York, N.Y.

Answer

For most amateurs the 1900 positions of the stars are sufficiently accurate since many of their telescopes are not set by circles.

The positions in the HANDBOOK are given just to the nearest minute of time in right ascension and minute of arc in declination. The stars are limited to those brighter than magnitude 3.51, and hence are visible to the naked eye. The greatest value of the precession in 42 years is about 10 min. in R.A. and 14′ in Dec. Thus the star would in all probability be in the finder field when set by 1900 positions.

The determination of the accurate position of a star for a given date is a rather involved process. The formulae for the effect of precession are

$$\Delta\alpha = \theta\ (\cos\epsilon + \sin\epsilon\ \sin\alpha\ \tan\delta),$$
$$\Delta\delta = \theta\ (\sin\epsilon\ \cos\alpha),$$

where $\Delta\alpha$, $\Delta\delta$ are the changes in R.A. and Dec. in seconds of arc per year, θ is the general precession and ϵ is the obliquity of the ecliptic. These latter two quantities are given in the American Ephemeris by

$$\theta = 50''.2564 + 0''.000222\ (t - 1900),$$
$$\epsilon = 23^\circ\ 27'\ 08''.26 - 0''.4684\ (t - 1900).$$

This is just the progressive part of the change in position. The periodic part, called nutation, further complicates the problem. However, for most purposes the above formulae are sufficient. The most convenient way to utilize them is to make tables or a graph for the given time-interval and for selected values of R.A. and Dec., such that interpolation to other values would be a matter of mental arithmetic. The advisability of incorporating such a graph in the HANDBOOK has been discussed, but the conclusion reached was that it would not be of sufficient general interest to warrant the labour and expense involved. Reference may be made to Smart's *Spherical Astronomy*, chapter 10, for formulae and an example.

R. J. N.

HIGH NOON

"They were married quietly at high noon on Saturday in the Parkdale Presbyterian Church."

This announcement caused a thought-wave on time-counting. The dictionary states that "noon" was originally the ninth hour of the day or three o'clock p.m., which was the hour of the chief meal; but that it was shifted to the middle of the day, the meal accompanying it. "High noon" is of course the time when the sun is high in the sky, that is, on the meridian, which the astronomer calls apparent noon. Now on January 24, the day referred to, the equation of time was 12 minutes, to be added to apparent time, the correction to standard time was 18 minutes, also to be added, and daylight saving added an hour more. Thus twelve by the clock, when the ceremony was performed, was an hour and a half ahead of the sun and it was not actually true high noon until an hour and a half later.

TEMPERING STEEL IN INNER MONGOLIA

In "Mongol Journeys" (1941) by Owen Lattimore, an American traveller and the editor of *Pacific Affairs*, the author gives many interesting experiences and odd observations. Among them may be quoted:

> We slept that night on the bank of the river. The next day we crossed. On the ferry the old Jahirakchi Taiji dipped the striking iron of his flint and tinder

set into the water. It was a good piece of iron, he said, and worth making harder by tempering it in the River of the Princes.

. . . . . .

There are also stories of wonderful "horse-thief" knives, specially tempered, which will cut the iron link of a horse-hobble in two blows—some say at one blow. One way to temper steel, they say—I do not know if the superlative knives are made in this way—is to take the hoof of a three-year-old horse which has begun to splay out from the compact form of a colt's hoof. Clear this in the fire; then sift out what has been charred to a dead black, take that which still has a yellowish tinge and mix it into a paste with salt and human sweat. Coat the blade with this paste and heat it, but not to a red heat; then plunge it in salt to cool. The black iron will turn to white steel.

Our readers will also be pleased to have the author's prediction regarding the future of this country in which there is friction between China, Russia and Japan:

I shall yet be able to do what once I had never hoped to do: ride along a border at peace and see a new and happy Mongolia at peace with a new and wholesome China.

. . . . . .

The war has already gone far enough to show that China cannot be defeated. Earlier in the war China could have been sold out but now, [December 1940] things have gone too far, and China is nobody's to sell. If other countries, of which America is the most important, actually increase their aid to Japan, China may be forced into revolution by the defection of part of the right wing. This would make the war longer, but even so, China would win. China's prospects in Mongolia must therefore be judged by the fact that sooner or later China will win, and it will be a complete victory. When China has won it will be well on the way to industrialization—started and developed as an indispensable step in winning the war.

The U.S.A.—1942

Methinks I see in my mind a noble and puissant Nation rousing herself like a strong man after sleep, and shaking her invincible locks: Methinks I see her as an Eagle mewing her mightly youth, and kindling her undazzled eyes at the full mid-day beam; purging and unscaling her long-abused sight at the fountain itself of heavenly radiance; while the whole noise of timorous and flocking birds, with those also that love the twilight, flutter about, amazed at what she means.

—From Milton's *Areopagitica* (1644)

C.A.C.

MEETINGS OF THE SOCIETY

AT TORONTO

October 21, 1941.—The Society met in the McLennan Laboratory, University of Toronto, at 8.00 p.m., with Miss R. J. Northcott presiding in the absence of Dr. D. W. Best.

Nine candidates were duly elected to membership in the Society, viz:

Mr. Frank W. White, 71 Sheldrake Blvd., Toronto.
Mr. Sydney J. Dawson, 81 Day Avenue, Toronto.
Mrs. Charles H. Kemp, 91 Hayden Street, Toronto.
Mr. Peter S. Favro, 160 Symons Street, Mimico, Toronto.
Mr. H. Buchanan, R.R. 1, Washago, Ont.
Mr. Clarence Ostrom, Alexandria, Ont.
Mr. John Love, Ayr, Ont.
Miss Amy McQuarne, 83½ King Street West, Chatham, Ont.
Mr. Harold W. Seekins, 11 Johnston Avenue, Hespeler, Ont.

Mr. Gerald F. Longworth, machinist at the David Dunlap Observatory, addressed the Society on "The Aluminizing Chamber for the 74-inch Mirror." He described the new method of coating telescope mirrors with aluminum to provide a reflecting surface which can be washed and from which dust can be removed without damage to the mirror. Silver coatings previously used were extremely fragile, being from .0008 to .0003 inch thickness. The silver surface deteriorated rapidly, required re-silvering about twice a year, and once on, could not be cleaned, Mr. Longworth explained.

A special chamber was constructed for the Dunlap Observatory for aluminizing the 74-inch mirror. Steel boiler plate, ⅜-inch thick, was used for the "bell" which is 7 feet in diameter and 5 feet high. To provide the desired low pressure of 1/20 μ (.00005 mm. of mercury) a mechanical pump was used to reduce pressure to 1/10 μ and then a diffusion pump to obtain the final high degree of vacuum. In this vacuum the aluminum is vaporized from white-hot tungsten filaments.

All joints and welds had to be made especially tight, and the entire "bell" sealed by lead wire and a rubber ring to the 1½-ton base plate. The inside of the chamber was coated with low-vapour-pressure wax, application of which took 3½ days. The wax was heated by a special torch applied on the outside to 180°C. As the pressure was reduced some trouble was had at first with fingerprints left on the inside "boiling off" and the inside of the chamber had to be cleaned with alcohol.

If the pressure is not low enough, Mr. Longsworth explained, the aluminum particles vaporized from the coils would collide with air particles and be slowed down so they would not strike the mirror surface hard enough to stick. Some difficulties were experienced at first with leakage of air into the chamber,

and the pumps were unable to counteract a leak of more than 1/10 cu. inch of air per minute. As the coils were fired combustion of oxygen in the chamber also resulted in pressure being increased.

The coils, consisting of four strands of 15-mm. tungsten wire were fired by a low tension transformer using 10 volts at about 80 amperes. Each of the 36 coils used for the 74-inch mirror was in operation about 15 seconds. Aluminum loops were attached to the coils to provide the metal for vaporizing. At the Dunlap Observatory the mirror was placed face up. In similar operations at Mount Wilson the mirror was turned over, while at Cleveland for the McDonald Observatory it was placed on edge. The glass surface had to be especially cleaned before aluminizing, Mr. Longworth added. A surface clean enough for silvering was not sufficiently clean for this process, he said.

Within a short time after the mirror was placed back into operation it was found that the aluminum coating cut exposure times almost in half, A silver surface reflects more of the visible spectrum than aluminum, Mr. Longworth said, but the ultra-violet light desired for the Dunlap radial velocity program was better reflected by the aluminum surface.

Dr. Helen S. Hogg presented the second paper in a series on "Explorations in Clusters and Nebulae," in which she dealt particularly with galactic clusters. Of the 334 galactic or "open" clusters known at present about two-thirds were catalogued by the Herschels. With a very few exceptions all galactic clusters are within the limits of the Milky Way. The exceptions are those which are very near the sun (which lies 10 parsecs north of the plane of symmetry of the clusters) and which appear to be outside the Milky Way merely because of their nearness and the angle at which they are observed.

The number of stars in a galactic cluster might vary from five to several thousands, Dr. Hogg said. It was difficult to say whether any particular star was a member of a cluster in which it appeared or merely a foreground or background star. There is a uniform distribution of clusters on the galactic plane up to 2000 parsecs after which they thin out rapidly to a limit of 5000 parsecs. Clusters undoubtedly exist beyond this limit but the search for them is hampered by background stars, absorption of light in the intervening space and the faint apparent magnitudes of the stars themselves. Only an especially rich cluster like h Persei could be photographed in blue light at a distance of 5000 parsecs. However, photography of the whole sky in red light with the large Schmidt reflector is now planned and may result in extension of our knowledge of galactic clusters to a distance of 10,000 parsecs or more.

Trumpler's finding that diameter of clusters seemed to depend on their distance led astronomers to suspect that absorption of light in space might be greater than hitherto believed, Dr. Hogg continued. Stars in galactic clusters are often exceedingly hot and brilliant, with radiation output several hundred times that of the sun. An abundance of white-blue stars with surface temperature three times that of the sun had been found in galactic clusters, she said. Examples of nearby galactic clusters cited were the Hyades group, about 100 light-years distant, and Coma Berenices, at a distance of 250 light-years.

FREDERIC L. TROYER, *Recorder.*

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1890-1941

The Society was incorporated in 1890 under the name of The Astronomical and Physical Society of Toronto, and assumed its present name in 1903.

For many years the Toronto organization existed alone, but now the Society is national in extent, having active Centres in Montreal, P.Q.; Ottawa, Toronto, Hamilton and London, Ontario.; Winnipeg, Man.; Edmonton, Alta.; Vancouver and Victoria, B.C. As well as about 700 members of these Canadian Centres, there are over 200 members not attached to any Centre, mostly resident in other nations, while some 300 additional institutions or persons are on the regular mailing list for our publications.

The Society publishes a monthly JOURNAL containing about 500 pages and a yearly OBSERVER'S HANDBOOK of 80 pages. Single copies of the JOURNAL or HANDBOOK are 25 cents, postpaid. In quantities of 10 or more copies, the price is 20 cents a copy.

Membership is open to anyone interested in astronomy. Annual dues, $2.00; life membership, $25.00. Publications are sent free to all members or may be subscribed for separately. Applications for membership or publications may be made to the General Secretary, 198 College St., Toronto.

The Society has for Sale:

Reprinted from the JOURNAL of the Royal Astronomical Society, 1936-1942.

The Physical State of the Upper Atmosphere, (revised 1941) by B. Haurwitz, 96 pages; Price 75 cents postpaid.

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